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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/804,363	03/18/2004	Lei Li	TI-36903	9235

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EXAMINER	
SANDVIK, BENJAMIN P	

ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 06/30/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/804,363	LI ET AL.	
	Examiner	Art Unit	
	Ben P. Sandvik	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) 13-20 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-12 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 3, 5, 7-10, and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shih et al (U.S. Patent #6329722), in view of Lansford (U.S. Patent #6157078).

With respect to **claims 1, 3, 5, 7, 8, 9, and 10**, Shih teaches a copper interconnecting metallization (Fig. 3, 310) protected by an overcoat layer, portions of said metallization exposed in a window opened through the thickness of said overcoat layer (Fig. 3, 360), comprising a plug of bondable metal positioned in said window (Fig. 3, 320), that the overcoat comprises silicon nitride (Col 4 Ln 25-27) regarding claim 3, a bondable metal plug that is aluminum (Fig. 2, 240 and Col 4 Ln 60) regarding claim 5, that the structure comprises a ball bond attached to said plug (Fig. 3, 330) regarding claim 8, but does not teach a patterned conductive barrier layer positioned on said copper metallization in said window, said barrier layer forming a trough having walls conformal with said window and a trough height less than said overcoat thickness.

Lansford teaches an interconnection plug that is positioned in a barrier metal trough made of tantalum or tantalum nitride, and having a thickness substantially equal to a trough height, with the trough height being less than an overcoat thickness, and that the plug has a surface on a flat level with said trough with regard to claim 7 (Fig. 4, 32). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a barrier metal on the bondable metal of Shih as taught by Lansford in order to prevent the diffusion of copper into the overcoat layer, and to make the barrier layer walls and the metal plug to be at a height below the surface of the overcoat layer in order to control the interconnect resistance.

With respect to **claim 12**, Shih teaches a copper interconnecting metallization (Fig. 2, 210) protected by an overcoat layer, portions of said metallization exposed in a window opened through the thickness of said overcoat layer (Fig. 2, 260), comprising a plug of bondable metal positioned in said window, said plug having a thickness substantially equal to overcoat height so that said window is a pad suitable for wire bonding, but does not teach a patterned conductive barrier layer positioned on said copper metallization in said window, said barrier layer forming a trough having walls conformal with said window and a trough height substantially equal to said overcoat thickness. Lansford teaches a barrier metal layer that forms a trough around the conductive plug and has a height that is level with said plug (Fig. 4, 32). It would have been obvious to one of ordinary skill in the art at the time the invention was made to

provide the conductive plug of Shih with a barrier layer as taught by Lansford in order to prevent the diffusion of aluminum into the overcoat layer.

Claims 2, 4, 6, and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shih and Lansford, in view of Matsuda et al (U.S. PG Pub #20020050459).

With respect to **claim 2**, Shih and Lansford teach all of the limitations of claim 1, but do not teach a thickness of the overcoat being about 0.6 to 1.5 μm. Matsuda teaches an interconnection device that has an overcoat layer with a thickness of 850 nm, which is 0.85 μm (Fig. 9, 101_2 and Paragraph 86). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the interconnection device of Shih and Lansford with an overcoat layer having a thickness between 0.6 to 1.5 μm as taught by Matsuda in order to meet the size constraints for the intended application of the device.

With respect to **claim 6**, Shih and Lansford teach all of the limitations of claim 1, but do not teach a thickness of the plug being between about 0.4 and 1.4 μm. Matsuda teaches that a plug is provided in the via hole with a depth of 600 nm (Paragraph 87) and is leveled off with the top of the overcoat layer (Paragraph 94). It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide the interconnection device of Shih and Lansford with a plug having a thickness between 0.4 and 1.4 μm as taught

by Matsuda in order to meet the size constraints for the intended application of the device.

With respect to **claim 11**, Shih and Lansford teach all of the limitations of claim 1, but do not teach that the barrier layer has a thickness between 0.02 and 0.03 μm. Matsuda teaches a barrier that is 20 nm, or 0.02 μm, thick (Paragraph 88). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the barrier film of Shih and Lansford to have a thickness of between 0.02 and 0.03 μm as taught by Matsuda in order to meet the size constraints for the intended application of the device.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shih and Lansford, in view of Ho et al (U.S. Patent #6645851).

With respect to **claim 4**, Shih and Lansford teach all of the limitations of claim 1, but do not teach that said wall height is between 6% and 30% less than said overcoat thickness, creating a step height of 0.1 to 0.2 μm. Ho teaches an overcoat layer with a thickness of 2000 to 20000 Angstroms (Fig. 12, 21 and Col 8 Ln 49-53) and a step height of 500 to 3000 Angstroms, or 0.05 to .03μm, (Fig. 12, H4 and Col 11 Ln 7-8) which is between 6% and 30% of the thickness of the overcoat layer. It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the device of Shih and Lansford with a step height as taught by Ho in order to control the resistance of the plug.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ben P. Sandvik whose telephone number is (571) 272-8446. The examiner can normally be reached on Mon-Fri.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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